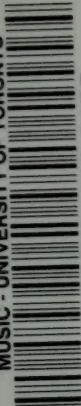
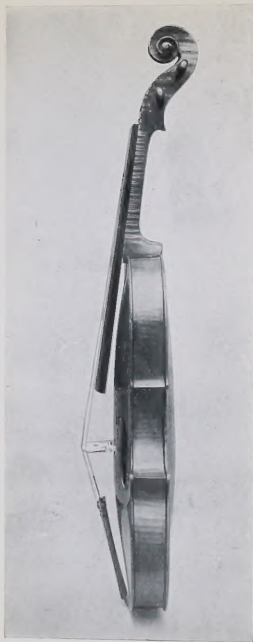


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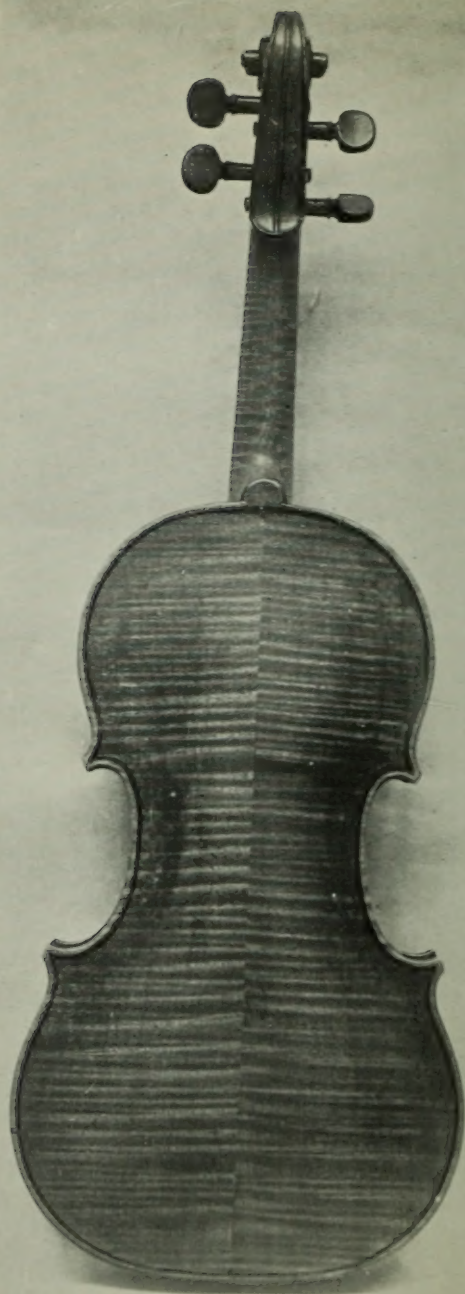


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"LE MERCURE" STRAD.





HOW TO MAKE A VIOLIN

by

JOHN BROADHOUSE

and

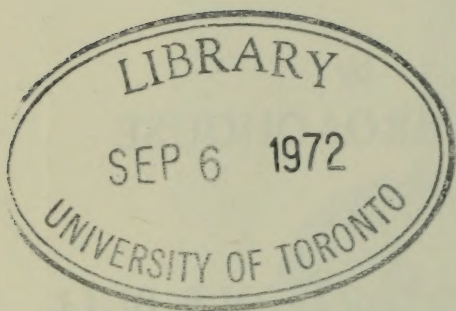
VIOLIN NOTES by OLE BULL

Revised Edition

LONDON

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FOREWORD.

THE demand for this little work on the construction of the violin has continued steadily for years and for a short time has been out of print. This present edition has been considerably improved and has had the advantage of being revised by one of our well-known violin makers. With a view of further improving this edition the outline illustrations of the models of Stradivarius, Guarnerius and Amati have been re-drawn and that of a Maggini added to the list.

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INTRODUCTION.

SO much has been written upon the violin, its history, its development, its beauties as a musical instrument, its musical literature, etc., that a collection of all the works to which it has given rise would form almost a library of themselves. Its history has been ably treated in a German work called "Die Violine, Ihre Geschichte und Ihr Bau." The only work, however, as yet given to English readers, I believe, which treats fully and concisely of the numerous details involved in *making* a violin, is the very fine but expensive work of E. Heron-Allen—a work complete in itself, but perhaps too costly for some who would like to try their hand at fabricating

a fiddle. Hints are given in many books, and in some of them a general outline of the process is furnished; the best I have seen is contained in "The Violin," by P. Davidson. By far the greater part of that interesting work is devoted to theoretical and historical matters, which, however, attractive in themselves, are not strictly connected with the making of the instrument. My object in writing this book is to afford the amateur detailed information respecting the various processes to be gone through in the workshop, from the time when the wood in the rough lies on the bench to the moment when the finished article is ready to be fitted with strings for playing. I do not think I have allowed any detail to escape me, if I have I shall be grateful to any reader who will communicate with me, so that the defect or defects may be remedied in a later edition. I do not for a moment suppose that my work is perfect, but I have tried to make it as full and complete as possible, and to explain in detail every operation necessary to construct a violin.

It is presumed that the amateur is sufficiently enthusiastic to make the attempt, and that he means not merely to make a common box of wood which will sound when played upon, but to produce instruments which will live after him, and to put his best work into every violin he finishes. Violins are turned out by the thousand every year, but cheap as they are, most of them are dear at the price paid for them because they are made without artistic intelligence, without enthusiasm, without love for the beautiful, and without that minute attention to each particular instrument which alone can secure a perfect work. So many backs, so many bellies, so many necks, so many finger-boards, so many bass-bars, so many sound-posts, are shaped to a given pattern, fitted together, varnished, and sent into the market as so many violins; but this is not the way to produce one good instrument. The amateur who reads this book doubtless knows all that can be learnt about the old masters whose names are household words in the violin world, and if

so, he knows that *they* did not work on this plan, but bestowed loving care on every single instrument, regarding the one work in hand as quite enough to tax all their energies and absorb all their artistic knowledge and experience for the time being. This is the spirit in which to work, the spirit which will regard every detail as equally momentous, and bestow as much time and trouble on the inside work which will never be seen, as on the outside work which will be seen. I would call the reader's attention to the remark of the eminent sculptor to the effect that "Trifles make perfection," but I would at the same time caution him against misunderstanding the quotation. In the making of a violin there are no "trifles," everything seen or unseen, great or small, beautiful or not beautiful, is of the first importance. The mason who carved elaborate details on figures in a cathedral, placed so high that the beauty of his work could not be seen and admired, made his work perfect *because the gods would see it*; does the amateur who

is about to begin to make a violin know what such enthusiasm means? Is he prepared to produce a perfect work, not merely to make a profit by it, not to win admiration for it, not to gain celebrity by it, but because the doing of genuine work, for the reason that it is genuine work, is the highest and purest pleasure known to the enthusiast? *This is enthusiasm.* The work will not of necessity be bad if profit or fame result from it, but it will certainly be bad if this particular kind of enthusiasm do not inspire every step taken in the process of doing it.

Few stories have been told oftener than that which tells how Sir Joshua Reynolds informed an inquirer that he mixed his colours *with brains*. That is the one single commodity with which I cannot undertake to supply the amateur violin-maker. No amount of instruction will enable a fool to make a fiddle.

No number of difficulties will prevent a man "with a head screwed on the right way about" from working through failure to success. These instructions are only

meant for people of the latter sort. For them the directions here given will be ample. Theories have been abundantly dealt with by other writers: this work is meant to be practical.

HOW TO MAKE A VIOLIN.

CHAPTER I.

THE PARTS OF THE VIOLIN.

TAKEN to pieces, a violin would be found to consist of the following parts :

*Back	2 Pieces
Belly	2 „
(4 Corners and 1 top and bottom blocks) }	6 „
†Sides	6 „
Side Linings	12 „
Bar	1 „
‡Purflings	36 „

* The back is sometimes made in one piece. It is then called “a whole back.” The same remark also applies to the belly.

† Bottom side is sometimes one piece only.

‡ The purflings are the narrow black ornamental double lines running round the outer edge of the back and belly. They are sometimes omitted.

Neck	1	Pieces
Finger Board	1	„
Nut	1	„
Bridge	1	„
Tail Piece	1	„
Button for ditto	1	„
String for ditto	1	„
Tail Piece Nut	1	„
Sound Post	1	„
Strings	4	„
Pegs	4	„

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(Four kinds of wood are used: maple, pine, ebony and rosewood.

Maple is used for the back, the neck, the side pieces and the bridge.

Pine is used for the belly, the bar, the blocks, the side linings and the sound post.

Ebony is used for the fingerboard, the nut, the tail piece, the tail piece nut and the button.

Rosewood for the pegs.)

CHAPTER II.

ON THE SELECTION OF WOOD.

THE maple and pine are the sounding woods of the violin, and the tone of the instrument depends chiefly upon the quality of wood chosen. It is a pity to waste good work on bad wood, and the following points must be carefully observed in selecting both the maple and pine:

(The tree should have been cut in December or January. At that time the sap has ceased to flow, and wood cut down then is always richer in sonorous qualities than that cut at any other time.)

It must have been seasoned for six or seven years before use, more, if possible, but never less. Artificial means have been employed to hasten the effects of seasoning, and make the wood tough, elastic and resonant, but seasoning is the only genuine, be-

cause natural mode of attaining this end, and I advise the amateur to avoid baked wood, or wood dosed with chemicals, as he would the plague. The longer the wood has been seasoned by being kept in a dry and airy place and protected from extremes of heat and cold, the better will it be for violin making.

(The wood must be perfectly free from knots, quite sound, not worm eaten, and without flaw of any kind. The grain must be perfectly straight and run lengthwise. The maple must not be too hard or too soft, in the first case the tone will not come freely at the touch of the bow, in the second, it will be dull, muffled and entirely without brilliancy.) This, like many other matters in connection with our subject, is a question of judgment and experience. Vuillaume, of Paris, travelled in Italy and Switzerland for the express purpose of procuring pine wood, and bought chairs, tables and other articles of furniture whenever he found the kind of wood he wanted. As it is not possible for every would-be maker to follow his example

I recommend the amateur to buy the wood he requires from a violin-maker of repute. These are to be found in London, Paris, and even at Mirecourt, the French town where so many common violins are made by machinery to order. For good material a high price will be asked, and very valuable pieces of back and belly wood are worth almost their weight in gold. A maker in London once showed me two pieces of maple sawed into shape for a back, which he said he would not sell, even in the rough, for twenty pounds apiece.

It is not of course necessary or desirable that the amateur should make his earliest experiments on costly wood, on the other hand, I recommend him to make his first fiddle of cheap material, so as to familiarise himself with the tools and the way to use them. When this experience has been acquired, it will be soon enough to try to turn valuable wood into an artistic and really excellent violin.

(The wood must be cut from the south side of the tree. The old Italian makers took

great care to select wood of this kind, because they found it more sonorous and brilliant in tone. The maple should be free from red or brown patches, that which is of an uniformly whitish tint is the best.

The pine should be white and of perfectly straight grain throughout the length of the instrument. The very finest grain is not so good as that which has an open space between the fibres. The least knot, fault, flaw or curve in the grain will render the piece useless. No other wood but pine is ever used for the belly, though the back has occasionally been made of other woods than maple. Figured wood is advisable if its sonority is not interfered with, as the beautiful and the useful may readily be combined. Some of the backs of Stradivarius combine beauty of appearance and excellence of tone in the highest perfection.

CHAPTER III.

THE TOOLS REQUIRED.

SOME of the tools used in violin making are commonly used by cabinet-makers and carpenters, and others are peculiarly fitted for their special purposes. They may be bought at a good tool shop.

The work-bench or table, need not be larger than 4 ft. by 2 ft. A wooden vice should be attached to one end. The surface should be quite smooth and kept scrupulously clean. The following tools are required :



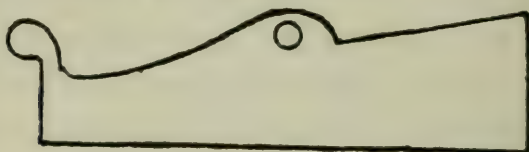
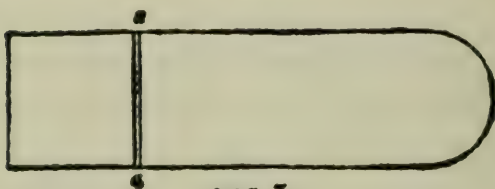
FIG. I

Three saws one of the usual kind for sawing the larger pieces (24 inches of blade will be plenty), a hand saw for the more

delicate work, and a bow saw for outline work.

Three chisels, $\frac{3}{16}$ inch, $\frac{3}{8}$ inch, and 1 inch broad respectively.

Eight gouges, ranging from $\frac{1}{8}$ inch to 1 inch broad, will be necessary.

**FIG. 2****FIG. 3**

A flat-bottomed plane 8 inches long. The illustrations show the kind of plane required. Fig. 2 is the side view of the body;

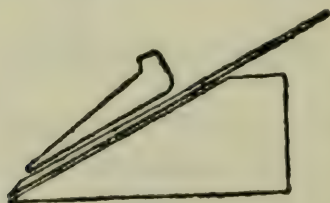
**FIG. 4**

Fig. 3 is the bottom view, *aa* being the slit for the blade; Fig. 4 shows the loose pieces detached, which, when fixed, keeps the blade in its place; and Fig. 5 shows the plane

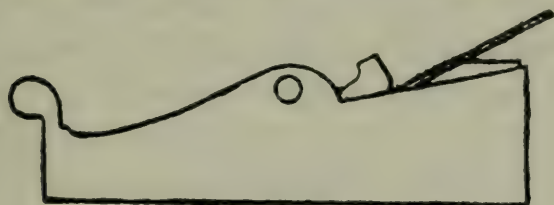


FIG. 5

ready for use. The blade must be kept very sharp, or it will tear the wood instead of taking off a thin clean shaving.

If the maker buys his wood in the tree, and decides to season it himself, he must cut his maple for the *necks* into pieces 12 inches long, $2\frac{1}{4}$ inches deep, and $1\frac{3}{4}$ inches broad, the grain running on the broadest side. Stack the pieces so that the air gets freely to them. The pieces of maple and pine for the back and belly must be 16 inches long, 6 inches broad, but conical in shape, the broader edge being $1\frac{1}{8}$ inches and the narrower $\frac{1}{4}$ inch. Authorities are divided as to whether the heart wood or the outer edge should be joined

in the middle of the instrument. Mauzin, a French author, says: "Il faut avoir soin . . . de mettre la partie du *cœur* de l'arbre c'est-à-dire les veines les plus rapprochés, *dans le centre de la table.*" Mr. Davidson, in the work referred to in the introduction, says the "two thickest edges" should be "the *bark side* of the tree," and yet he says later on, after giving directions for planing and joining the thicker edges to make the back and belly: "It will thus be seen that the centre of this joined plate contains the interior or heart wood." If, as he says, the two *thickest* edges are the *bark side*, it is impossible that the centre of the joined plate can contain the *interior or heartwood*.*

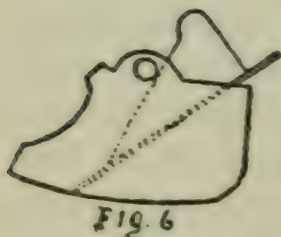


Fig. 6

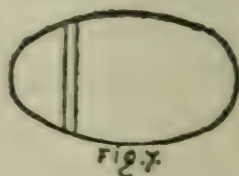


Fig. 7.

* As a matter of fact the bark side is in the centre or jointed part of the instrument, this applies to both back and belly.

Three small planes, with rounded bottoms. Figs. 6 and 7 show what these tools are like.

The smallest should be of the size shown; the second half as large again; the largest twice the size of the smallest.

Three or four knives of the shape shown in Fig. 8, with blades ranging from 1 inch to 3 inches in length.

Two or three scrapers, like those used by cabinet-makers, but with rounded edges. The necessity for this difference will be seen later, when the use of the scraper is explained. One scraper will be required with the edge shaped as Fig. 9.

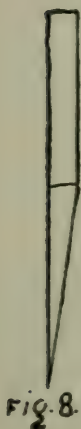


FIG. 8.

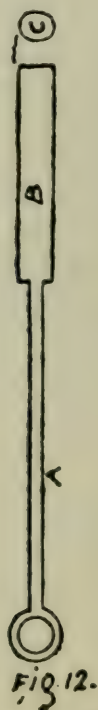


FIG. 9.



FIG. 10.

A pair of steel compasses for measuring the thickness of the back and belly, shaped as in Fig. 10. These must, of course, be large enough to allow the back and belly pieces to be measured with equal facility from any point of the edge.

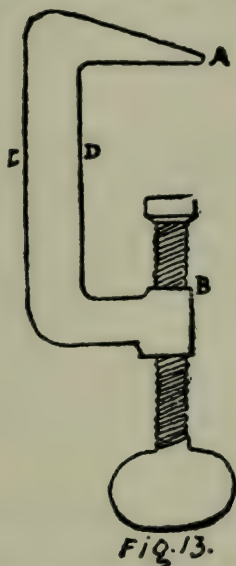


A steel trace, with one leg shorter than the other, Fig. 11.

A bending iron, for giving shape to the

side pieces and side linings, Fig. 12. The body (B) is of an oval shape (C), Fig. 12, and 6 inches long, the length of the oval being 2 inches and the width 1 inch. The handle (A) should of course be long enough to prevent burning the hand when the body (B) is heated.

A hand-vice, Fig. 13; the opening from A

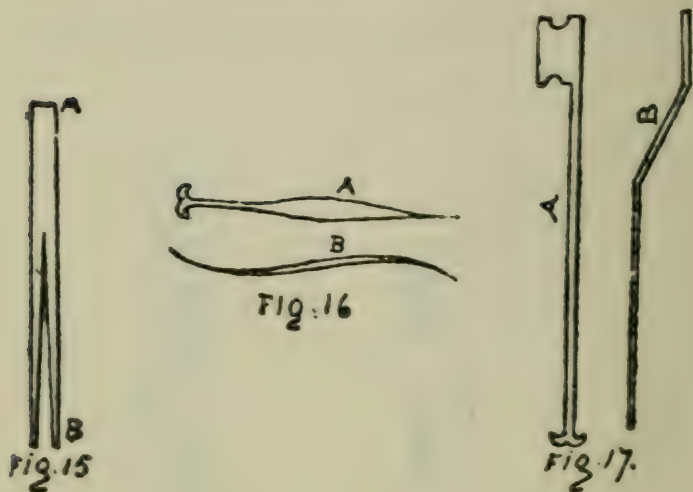


to B should be about $3\frac{1}{2}$ inches, and the breadth, C to D, about 1 inch.

Sixteen or eighteen hand-screws, made of wood, of the shape shown in Fig. 14, and

measuring 3 inches from A to B. C should be 1 inch thick. In using these hand-screws, a piece of cloth must be put on the violin to prevent marks of any kind.

A clip of wood shaped like a clothes-peg, Fig. 15, 1 inch wide at A, 2 inches from point



to point at B, its length is 9 inches and its thickness $\frac{3}{8}$ inch, and is used for glueing in the bass bar, five of these being required. It should be made of hard wood.

Another clip of a similar kind, but only 2 inches long. The inner surfaces of these

two little tools must be as smooth as possible, so as not to "chafe" the violin.

A sound-post setter, which is made of steel and shaped as in Fig. 16, where A shows the surface, and B the bend of the tool. It should be 8 or 10 inches long.

Another form of sound-post setter was used by Spohr. Its shape is given in Fig. 17. The bend B enables the setter to be applied to the head or foot of the post at will.

The best tools should be procured which it is possible to buy ; the art of violin making is not an easy one, and its difficulties are indefinitely multiplied by bad tools.

CHAPTER IV.

THE MODELS.

BY "a model" is meant a flat piece of wood, Fig. 19, about $\frac{1}{8}$ inch thick, which affords a means of drawing the shape which any part of the violin is to take. Great care will be required in shaping these models, as upon them the accuracy of the finished work depends.

While the amateur will naturally wish to copy the outline of an instrument by one of the great masters, it is not to be supposed that he will possess a back or belly by Amati, Stradivarius or Guarnerius. I therefore give the outline of a violin by each of these masters: *see large folding plate.*

A model of either may be made as follows: draw the outline on tracing paper, or, better still, cut out the model chosen from

the woodcut, and paste it on a thin piece of mahogany, having first made the straight edge representing the centre joint quite smooth and even with the plane. Then cut



out the mahogany the required shape, with scrupulous care, filing out the corners and inlet with a fine file. The shape thus obtained will answer very well if it is carefully done, and can be kept for future violins. The name of the maker of the original instrument taken as the model should be written on the mahogany in ink for identifi-

cation. If it is preferred, the full model can be made in the same way by cutting out another piece of paper, the shape of that taken from the wood-cut, the following will then be the form of the model :

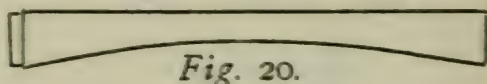


Fig. 20 shows the model for the curve of the back and belly taken lengthwise.

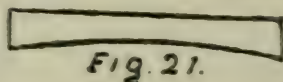
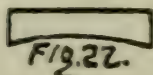


Fig. 21 shows the model for the curve of



the instrument at its greatest width, and Fig. 22 the curve over the *f* holes.

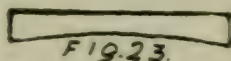


Fig. 23 shows the model for the curve at the widest part at the neck end.

Fig. 24 shows the model for drawing and placing the *f* holes. It will be observed that the position and shape of the *f* holes varies in different instruments, and a model must be made to suit each style adopted.

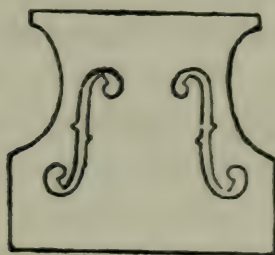


FIG. 24.

The four models shown in Figs. 18, 19, 20 and 21 can only be properly made by adjusting them to the back of another instrument. If the amateur cannot obtain access to a good violin for this purpose, he should purchase a copy of a Stradivarius, which can be bought tolerably cheap. If it seems strange that I should recommend a trashy copy as a model for the arching of a good violin, it must be remembered that the Mirecourt copies—those, at any rate, of the better kind, are made accurately to a scale taken from

the instruments of the best period of Stradivarius, and are correctly made so far as shape is concerned. If the amateur prefers to make these models of arching by his eye alone, he must bear in mind that Stradivarius, following the example of the Amati family, began with a high arching, especially between the *f* holes, but as he gained experience he found that the lowering of the arch contributed to fullness and brilliance of tone, and the violins of his best period have the lowest arching of all. The chapter on the mathematical method of finding the outline gives a mode of determining the shape of the arch lengthwise; this being once obtained and the model made, the transverse arching will of course be determined by that, as the arches at the upper and lower widths and also at the *f* holes must necessarily fall from the given height of the lengthwise arch to the level near the edges.

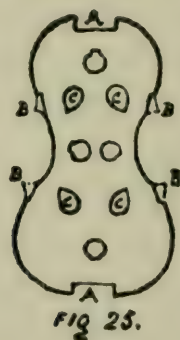
The scroll must also be formed from a good pattern. A good neck and scroll can be bought at all instrument dealers and kept as a model. Directions for carving the

scroll will be found later on. Various methods have been devised for making a model of a scroll without a pattern, but those methods are very cumbersome in operation and uncertain in result, and I recommend the amateur to buy a scroll from Hart, Hill, Chanot, or some other London maker of repute. He can work from this pattern, always knowing that his model is as good an one as can be obtained.

CHAPTER V.

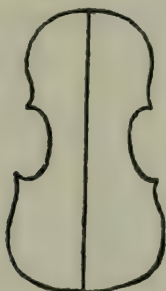
THE MOULD.

THE mould, which, properly speaking, is a "tool" as much as those mentioned in the chapter on tools, is a piece of wood cut in such a shape as to allow



the blocks, side-pieces and side-linings to be fixed in their proper places, so as to form the true foundations on which the violin is to be built up. This mould is represented in Fig. 25. At A A are the inlets for the two top

and bottom blocks, and the four pieces marked B are for the corner blocks which fill up on each side of the two circular inlets, for the solid basis on which the back and belly are afterwards glued.

*Fig 26*

The mould is begun by making a model exactly the shape and size of that for the back and belly, Fig. 19. Lay on the bench the piece intended for the mould and put upon it the model already made, Fig. 19; mark the outline with the point of the tracer, and with the saw and knife clean away the wood, and then with the file dress the edges until they correspond exactly with the pattern (the four corners may be left sharp). This piece will then be of the shape of Fig. 26, and is called the counter mould.

Now take a piece of hard wood (walnut is the best for the purpose) $\frac{3}{4}$ inch in thickness and a little larger than the model in Fig. 19. This piece is meant for the mould itself. . . . Lay it on the table, and the centre mould upon it, and trace on it the outline of the latter with the tracer. Then, with a rule, trace the inlets A A and four inlets at B B B B, as in Fig. 25. The dark line shows the shape of the mould; the dotted lines at B represent the corner blocks. Remove the superfluous wood with the saw and knife, finishing off with the scraper and file.

It is absolutely necessary that the sides of the mould, in all their extent, should be perfectly square with the surface. Any deviation from this rule will throw the side-pieces out of the upright when they come to be fixed, the edges of the mould being the only means of enabling the side-pieces to be glued to the corner blocks in an upright position.

Next pierce the eight holes shown in Fig. 25. The top and bottom holes are to be

respectively $1\frac{1}{4}$ inches (or 15 lignes French measure) from the inner edge of the inlets A A, the four marked C 1 inch from the inlets B B B B; and the two in the centre 1 inch from the inner edge of the C curves.

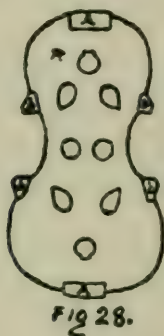
Eight other pieces must now be added to the mould.



This figure shows the upper mould surrounded by the eight pieces in question. They must also be of walnut, and of the precise depth of the side-pieces, viz., $1\frac{1}{4}$ inches, and must be dressed with the scraper and file till they fit perfectly close to the sides of the mould.

The next figure shows the mould, with the blocks (A A) (B B B B) fitted in their places.

X These blocks must be of pine, of perfectly even grain and a trifle over $1\frac{1}{4}$ inches high to allow for trimming. The blocks should fit perfectly in their inlets, and their grain and that of the corner blocks also must run *across* the instrument. This gives solidity to the body.



The blocks being prepared, put a mere spot of glue on the edge of the mould in each of the six inlets, and fix the pieces of pine so that they all stand exactly at the same height. They should project beyond the surface of the mould underneath, but only $\frac{1}{16}$ of an inch.

When the glue is dry, trim off with the knife and file the projecting $\frac{1}{16}$ of an inch,

and file the blocks perfectly level with the underside of the mould, this being the side on which the back will be glued. The ruler must be used to ascertain that the surface corresponds perfectly with that of the mould.

Lay the upper mould on the mould so that the outlines of the two are quite square with each other, and trace out the shape of the former on the blocks. Then cut away the extra wood with a suitable gouge and trim with the knife and file till the blocks are the exact shape of the upper mould. The mould and blocks will then be of the shape of Fig. 26 (page 29). Work slowly and measure constantly with the square to see that the outer edges of the blocks are perfectly square with the surface of the mould.

It is now time to speak of glue, which must be of the best quality and made with the utmost care. This is the more important because no other material is used for holding the parts of the violin together. The best glue is that known as Cologne glue. It is pale in colour and sold in pieces 6 or

8 inches long and 2 wide; it is very brittle and whitish at the broken edge. Common glue is of no use at all. Break a quantity in small pieces and put it in cold water for four hours, which will soften and swell it up. Then take a small glue pot of the ordinary kind, but with the inner vessel *enamelled*. Add water slowly; when the glue is all dissolved it should be of the consistency of very thick oil. *Take care that it never boils.* The glue should always be used very hot, but never boiling. While making, stir it gently with a stick of pine wood, and in using it apply it to the wood with a large camel hair pencil. In summer, glue will dry in four hours; in winter it needs twelve, and, in the latter case, the edges of the wood should be carefully warmed before the glue is put on. When two pieces are glued together, scrape away with a chisel any drops which escape, *while they are hot*, or with a pencil dipped in warm water. It cannot be too often repeated that *only the very best glue obtainable is of any use for violin making.*

CHAPTER VI.

THE SIDE-PIECES AND SIDE-LININGS.

SAW out a piece of maple 30 inches long, 4 inches wide, and $\frac{1}{10}$ inch thick. The grain should run lengthwise. Lay it on the bench at one end and clamp it down with the hand-vice. Plane the surface all over (going away from the vice), then unclamp it, turn it round, clamp the clean end down, and plane the rest. This time a flat bit of wood must be put between the hand-vice and maple to prevent the planed surface from being marked. Plane the other side in the same way, till the piece is reduced to a thickness of $\frac{3}{8}$ inch.

On account of its peculiar grain maple is very difficult stuff to plane, and the plane iron must be dressed so as to project very

slightly, or it will tear the wood and not smooth it. The most wavy and ornamental pieces are at the same time the most difficult to plane, and best suited for the side pieces.

The piece is still too thick, but it must be carefully scraped till all inequalities left by planing are removed and the strip is smoothed to a nice polish on the surface which will be outside the violin.

Now take the tracer and mark your piece into three strips of equal width. Divide them carefully with a knife. Take the plane bottom upwards, between your knees, and, holding each strip in your hands, move the edges along the plane iron till each is exactly $1\frac{1}{4}$ inches wide.

To divide them into proper lengths, measure with a strip of paper round the upper curve of the mould from the point where the neck is to join the block to the corner of the block. Allow for trimming and join at this corner. In the same way measure the inlet, allowing for trimming and joining at both ends. Then measure from the lower corner to the centre of the

lower block. Cut two strips to each length. *Cut the pieces long enough.* The next operation is to bend the strips, which is done with the bending iron. Heat it in a stove, but not hot enough to char the wood. Fix the handle in the bench-vice, and, taking one of the strips, dip it in cold water and bend it to the required shape very gradually. If you are too hasty you will certainly break the strip. Keep the strip damp by frequent dipping. A little practice soon renders this operation easy, but care must be taken to curve square with the width, in other words, when bent, the side-piece should touch the bench at every point of its edge.

The side-pieces can now be fixed. At the four corners and at the point where the sides meet at the lower block the joint must be trimmed and filed till it is perfect. The eight pieces of walnut before mentioned, of the depth of $1\frac{1}{4}$ inches, will now be wanted. Fig. 27 (p. 31) shows them in their places, and their use is to hold the sides to the blocks to which they are to be fixed by means of glue. Rub the edges of the

mould well with soap, taking great care that the soap does not touch the blocks. Glue the two blocks in the C inlet, put the side-piece in its exact place, fix upon it the walnut block, take a hand-vice, and, putting the beak in the hole nearest the C inlet, fix the screw on the outside of the walnut block and tighten screw until the side-piece presses firmly against the soaped mould and the glued blocks. So for the other C inlet.

Glue the upper block and the corner block, lay on the side-piece, add the walnut blocks, clamp up with hand-vices as before, using the holes nearest to the glued block. The side-pieces will, of course, be level with the mould on the under side, and project on the upper surface. At the upper block leave a space of $\frac{1}{3}$ inch, at the lower block the joint must be perfect. To do this properly, run the corner end first, glue the block and clamp, and do the same with the other side-piece, leaving the two ends free. Then bring them together at the lower block and make your joint perfect

before gluing the block; glue the block and clamp up. It is now clear why the eight holes were made in the mould.

When dry and firm, remove the vices and trim the blocks to the level of the side-pieces. It is hardly necessary to say that this must be done slowly and with exceeding care, lest the side-pieces should be disturbed.

It is usual to have the sides slightly narrower at the neck end. This narrowing must now be done. With the knife and file take off the neck block and side *not more than $\frac{1}{8}$ of an inch*; the height of the sides must then be graduated all round, starting with $1\frac{1}{4}$ inches at the lower end and finishing $\frac{1}{8}$ inch less at the upper end. This operation requires great care.

The side-linings may now be made and put in. They are of pine, $\frac{3}{16}$ inch broad, $\frac{1}{8}$ inch thick at the thicker and $\frac{1}{16}$ inch at the thinner edge. They are bent by the same means as the sides, glued in with the thicker edge level with the edge of the sides and held in their places

with wooden chips. When these are dry, take a fine knife and separate the blocks from the mould, round off the blocks with a gouge, and the outline of your violin is complete.

CHAPTER VII.

THE BACK.

THE back and belly are made in the same way, save that the latter is left thinner than the former, of which hereafter. In form and arch they are precisely the same.

Take two pieces of maple shaped thus, and of the size previously indicated, Fig. 29.

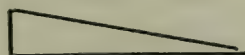
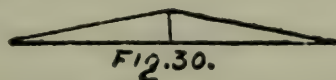


Fig. 29.

Plane the surface and the thicker edges, and lay the two pieces together on the table thus, Fig. 30.



These two when glued together will form the back of the violin, the ridge being the

position of the arch. If you decide to have your back in one piece, its size must be that of the other two laid together, and its shape thus, Fig. 31.

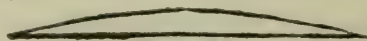


Fig. 31.

If you use two pieces, plane the thicker edges until they join perfectly. Glue them together. When the glue is dry, your back is ready for work.

Lay the two pieces (now practically one) on the bench, and having planed both sides perfectly, take the model (Fig. 19), place it on the flat side, *taking particular care that the joint corresponds with the centre of the model.* With the tracer point draw the outline of the model. Rigid accuracy is indispensable.

Saw round the outline with the bow saw, not going too near the line, as the knife and file have to follow to give the exact outline of the model. See that the edges are at all points square with the flat side.

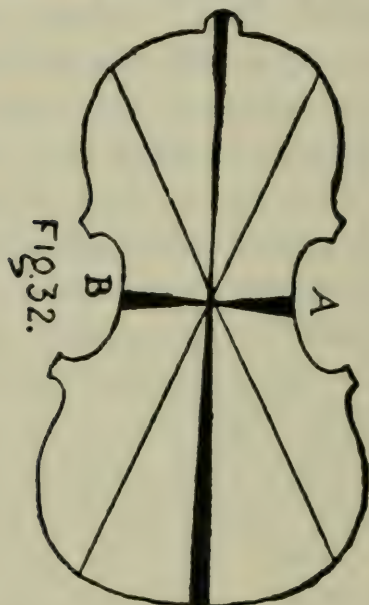
Open the tracer $\frac{1}{8}$ inch, take the back between your knees, and work a line all round

the edge at that distance from the flat side. This is the thickness the edge is to be.

Put the back on the bench, fix it with hand-screws, and with a large gouge give to it a rough resemblance of the shape which it must ultimately take. Do not hurry over this work. It is hardly necessary to remind the careful workman that when all the gouging, knifing, scraping and filing have been done, a certain thickness of wood must be left, and that one cut too deep at the outset will necessitate a fresh start. Begin by working along the ridge, so as to give to the joint a rough resemblance to the model of the arching lengthwise. Take short and shallow strokes with the gouge, cutting off only very small chips at a time, and be sure and leave enough wood for the operations which are to follow. When this is done there will, of course, be a cavity, like a miniature railway cutting, getting deeper as you get further away from the centre.

Now begin again from the centre, and work out in the rough the arching down to the middle of the C inlets.

Next clear away from the point where the two archings meet, four sloping lines diagonally, to the middle of the upper and lower curves. The back-plate will now resemble the following figure, Fig. 32.



Next clear away all the spare wood from the centre to the edges, and then with the smallest round-bottomed plane, make the whole surface tolerably smooth, until the two models fit with accuracy. The place where the shorter model should fit must be

found by taking the model of the / holes and marking through it the two notches on their inner edges. The highest arch must be across these notches.

Now take the same plane and clear out the groove or slight depression round the edge, so that the arching of the instrument falls away all round to the bottom of this little valley, from the level of which there will be a slight rise to the level of the outer edges.

Having thus got the outside of the back to the proper shape, as far as the small plane will do it, finish it off with the scrapers and fine glass-paper.

You must now turn the plate the other side up. Before doing this, however, put a piece of cloth or green baize on the bench, to prevent the outer surface of the back from being scratched. Under this cloth pieces of wood must be fixed all round, of such a height as to support the outer edges, and at the same time allow the middle of the back to rest upon the bench. The reason of this is obvious; if this precaution were not taken

the back would not remain still while the outer side was being hollowed out. In hollowing out the inner surface, care must be taken to leave level places where the blocks will have to be attached, and to leave more wood all over than will be the case when the back is finished. The compasses referred to in Chapter III, Fig. 10, will enable you to obtain the requisite thicknesses, which are of such vital importance that I have treated the matter fully in a separate chapter.

Now turn to Chapter IX, and reduce the back to its proper thickness all over as there directed. Having carried through this operation with great care, the outer edge of the back should correspond exactly in outline with the side-pieces, which are already fixed on the mould, and the back should project over the side-pieces $\frac{1}{8}$ inch all round. Now take a good, fine, biting file, and bevel very slightly round the whole inside of the edge, using a round file where the short curves render it necessary, and a flat one everywhere else; finish off with

medium sand-paper. If the fit is accurate, the back is ready to be glued on, which is done as follows: lay the back upon the side-pieces, in the exact place it is to occupy. Mark with a pencil on the edge of the back the joint where the side-pieces meet at the broad end of the instrument and also make marks at the four corners where the side-pieces are joined at the extremities of the C inlets. These markings are to enable you to lay the back in an instant, and without hesitation, in the place where you want it to be. The glue has to be used as hot as possible without boiling, and unless you can lay down the back in its exact place the moment the glue is put on it will lose its heat and its tenacity while you are shuffling the back about to find its place. Have everything ready, therefore, for a rapid and precise operation, so as to be in readiness the moment the glue is laid on. When you are ready, take the camel-hair brush, and lay the hot glue upon the side-pieces, put the back in its place, and secure it with the wooden hand-screws, putting two

on the upper block, two on the lower, one at each corner, and as many more as you can place round the edges. Each screw should have a piece of cloth placed upon its surface, to keep it from bruising the wood. The glue which has been forced out by the pressure must be at once removed with a camel-hair brush dipped in the hot water of the glue-pot. Let it stand till it is perfectly dry.

The belly is fixed in the same way when it is completed by the fixing of the bass bar as shown later on. When both back and belly are glued on, any variation in the projection of either beyond the side-pieces must be adjusted with the knife and file, so that the projection is perfectly symmetrical all round.

CHAPTER VIII.

OF THE BELLY.

IF the operator has succeeded in making a good back, either whole or joined, he will meet with no great difficulty in making the belly; the cutting out of the / holes being the only difference, and, moreover, the little projection at the smaller end of the back is not required for the belly. It must be remembered, however, that pine is much more fragile than maple, and will therefore require proportionately increased care in working; it must be worked with very sharp tools, and, as it is liable to split along the grain, the tool must be used both ways in getting out a curve, lest the wood split. "Measure twice before you cut once," cut lightly and delicately, and be content to take off a very small piece at each stroke

lest one unlucky gash should at the same time spoil your labour and your temper.

Take care that the joint follows exactly the grain of the wood, which should be perfectly straight from end to end, and that you get a faultless joint before glueing the pieces together. It is of great importance that the heart-wood—in other words, the part which grows nearest the centre of the tree, and consequently is of closer grain, should be on the side furthest from the joint.

In regulating the thickness of the different parts of the belly, follow the directions given in Chapter IX.

THE / HOLES.

Before these are cut out the belly should in every other respect be finished. Place the model of the / holes upon the belly, having, of course, first laid the latter upon the bench, taking care that the position of the model is accurately adjusted. Then with a pencil sharpened to a very fine point, carefully trace out the interior of the / holes in the model.

First of all, pierce the round holes above and below somewhat less than the tracing. Then introduce a very sharp penknife blade and cut away, little by little, all the wood within the tracing.

CHAPTER IX.

THE THICKNESS OF THE BACK AND BELLY.

WHEN the belly has been finished all but reducing it to its proper thickness, draw a line across the centre from the two in notches of the *f* holes, and draw by measurements a similar mark on the back. The middle of this line will in each case be the starting-point of the operation for reducing the wood to its proper thickness. This operation requires the most scrupulous care, as upon its successful performance the vibrations of the instrument, and consequently its quality of tone, will entirely depend.

The lines above mentioned must be drawn upon the *inside* of the belly and back. Now open the compasses exactly $\frac{3}{4}$ inch, and, putting one leg of the compasses on

the centre of the line, mark off that distance on either side from the centre point. These two points will therefore be $1\frac{1}{2}$ inches, or double the distance between the compass points apart. Now with the ruler draw through these two points lines parallel with the joint 3 inches towards the top and 2 inches towards the bottom. Join these lines at their extremities, and you thus have a rectangular space 5 inches long and $1\frac{1}{2}$ inches wide. All the wood of the belly in this space must be $\frac{1}{8}$ inch thick.

This thickness must be diminished gradually from $\frac{1}{8}$ inch (or $1\frac{1}{2}$ lignes French measure) at the edges of the rectangular space down to nearly $\frac{3}{16}$ inch at the points where the belly joins the blocks,* and the same thickness must be left all round the under surface of the belly where the groove or valley runs just within the outer edges of its upper surface. *Take care that this diminution is gradual, and not by jumps and steps.*

* Some makers advise $1\frac{1}{2}$ lignes all over, but a little thicker by the soundpost.

The thickness of the back is obtained in precisely the same way, *but the back must be throughout a trifle over $\frac{1}{4}$ inch thicker than the belly.* In other words, the rectangular space on the back will be $\frac{1}{4}$ inch thicker than that on the belly, the groove round the edge $\frac{1}{4}$ inch thicker, and the gradual diminution from the one to the other $\frac{1}{4}$ inch thicker at the corresponding points.

To ensure these thicknesses being correctly obtained, make a small wedge of some hard wood $\frac{1}{8}$ inch thick at the broader edge, $\frac{1}{4}$ inch at the centre, and $\frac{1}{16}$ inch at the thin edge. This will serve to adjust the compasses, the buttons of which must be put at the thickness required, and fixed at that position by the screw. Work with the small plane and scraper.

Note the following: the strokes of the plane will take away your pencil lines, and fresh ones must be drawn at each measurement. Do not trust your eye, but work rigidly to the exact rectangular shown by the pencil marks.

The plane and scrapers must not reduce your wood to the given thickness; these must be finished and brought down to their proper gauge with glass-paper. The glass-paper is the last "tool" to be used on the wood, and when the rectangular is thus finished, the compass buttons should move quite easily over it, *but touch it at all points.*

Make a second hard wood wedge for the back, of course $\frac{1}{4}$ inch thicker in all parts than that for the belly.

CHAPTER X.

THE BASS BAR.

THE making and fixing of this important member will finish the interior work of the violin. It is made of pine, fixed parallel to the joint and between it and the left / hole. Its purpose is to give depth and power to the third and fourth strings.

The bar should be $10\frac{1}{2}$ inches to $10\frac{3}{4}$ inches long, $\frac{1}{8}$ inch thick, $\frac{1}{3}$ inch deep at its centre, and tapering off to the thinnest strip at the ends. The edge glued to the belly is, of course, curved to fit precisely, the other edge is straight. The centre of the bar falls on the line joining the inner notches of the / holes. The grain of the bar must correspond with that of the belly.

The measurements here given are for the thickness of belly and back above in-

timated; but the proportions of the bar differ in different violins.

Take care that the bar is at right angles to the surface of the belly and that the curved edge fits the belly with the greatest possible exactitude. Glue that edge and fix the bar parallel to the joint, so that the outer edge of the bar is $\frac{1}{16}$ inch from the inner edge of the upper circle of the / hole on the bass side. Clip it with the clips shown in the chapter on tools (Fig. 15), and let it dry, first removing the superfluous glue with a wet camel-hair brush as before.

Some writers contend that the bass bar would be of greater service if glued diagonally to the grain. The amateur who wishes to do so can easily test this for himself. The following opinion of an American maker (Mr. W. H. Colton) is not without interest. Mr. Colton was a friend of Ole Bull, and the "note" is from the life of the latter, published at Boston in 1883:

"The oblique position of the bar has not been generally adopted. The bar is ordin-

arily placed with its outer side on a line parallel to the centre line or glue joint of the top, and at a distance from it about equal to one-half the width of the bridge, measured from the outer extremities of the feet. A slight spring is given to the ends of the bar, so that when glued to the top it produces an upward pressure at the centre, under the foot of the bridge. This pressure should equal the downward thrust of the bridge, the force of which will depend upon the angle of the strings over its top. Practice soon discovers a certain medium of spring which agrees fairly with a certain height of bridge.

An entirely successful result is not always insured, but a positive failure is avoided. But in the case of the oblique bar, no such common factor can be found to fit all cases, even averagely well. Each instrument presents its own particular problem. The spring at each end must be accurately determined by mechanical means, which will take into account both the resistance of the top, due to its comparative strength of fibre and the resistance due to the form of

modelling. The same degree of obliquity and position relative to the foot of the bridge which it supports, will not answer equally well in all cases. But when the required conditions are fulfilled, the oblique bar does beyond doubt very greatly increase the depth and volume of tone, particularly of the lower strings. Mr. Bull spent many years in attempting to formulate the rules which govern this most perplexing part of the organism of the violin. His observations and experiments demonstrated to him the correctness of the oblique position; and though, as was his wont, he frankly owned to more failures than one, his instances of success illustrated by his Da Salo and many other instruments, bore most convincing witness to the truth of his theory."

Ole Bull's own opinion on the matter is thus expressed in his "Violin Notes":

"The principal object of the bar is to resist the pressure of the strings upon the top. All old violins require to be rebarred, owing to the height of the present musical

pitch over that of one hundred years ago. The old short bars are no longer adapted to the greater strain, and more powerful ones are needed. From long-continued strain, the pulling of the two extremes towards the centre, and the downward pressure of the bridge at that point, the tops of many old violins have bulged up at the ends and sunk down at the centre. The adjustment of a new bar will tend to remedy this. As the bar was originally placed by Gaspar Da Salo, so it should be placed now, that is, not in the direction of the fibres of the top, but obliquely, the end under the fingerboard being nearest the centre. In this position it appears to give ample support to the bridge and to allow a fuller and richer tone.

CHAPTER XI.

THE PURFLING.

THE purfling is the ornamental black lines running round the outer edge of the back and belly—made of two lines of black with a strip of white wood between.

The wood for the purfling can be bought ready made at any violin maker's, and it is better to buy it than try to make it, as good machinery is needed to do the work well.

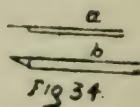
The grooves for the insertion of the purfling are made with a purfling tool. The distance of the purfling from the edge is a matter of taste. When decided, open the tracer to the required width and fix it with the screw; put the violin on your knees, and trace the first line, running one limb along the outer edge (which is still square,

the rounding off comes later). Then trace the second line in like manner. The purfling tool is then adjusted to the required distance. The following description of an excellent purfling tool, directions for use are from Mr. Davidson's book on "The Violin."

"By this instrument, it will be perceived we can vary the distances from the edges, to imitate any model chosen. The two cutters are thin pieces of steel, sharpened at an angle, with a shoulder left of the necessary thickness, so that the groove cut may fit the indenting strips. The two cutters are kept in position by the screw *a*. Fig. 34*a*



Fig 33.



represents one of the cutters, seen edge-ways; Fig. 34*b* shows the form of blade

and point. There is a small screw for adjusting the shoulderpiece to any required distance the purfling may be intended to be placed, Fig. 33*b*. This tool may be made from iron—with the exception of the cutters, of course—and fixed in an ordinary tool-handle. Another purfling tool, but much simplified, is shown in Fig. 35. The body of



Fig 35.

this tool may be formed from a piece of beech, having two cutters the same as the preceding, fixed by a binding-screw. This simple tool answers admirably, and may be easily made by any amateur, or can be purchased for about three shillings and six-pence. The angular parts of the blades must be made thin, and the edges kept very keen. Either of those two tools is to be held

quite steady, and a double cut of the proper depth run round the margin of the back and breast, the interior wood is afterwards to be cleanly cut out with a chisel-sharpened awl.* The indenting groove must be cut gradually and carefully, never allowing the tool to tear the wood, or slip from the proper place. At the parts of the back and belly opposite to the extremities of the neck, where the indenting tool does not reach, two pencil lines may be drawn through the spaces, and the groove cut to such lines with a thin pointed knife, and the wood cut out as previously."

When the purfling tool has been run twice along the intended groove, take a sharp knife and cut away enough wood from the groove to allow the awl to enter. The next figure shows the shape to which the awl should be bent and the way the point should be ground. A shows the side view, and B the front view of the point. When you have

* By a "chisel-sharpened awl" is meant a cobbler's awl, narrow enough to run easily in the width of the groove made by the purfling tool but ground to a *flat and sharp edge*.

b



Fig 36.

cleared away with a knife a starting-point for the awl, begin with the point of the awl and turn up the strip of wood intended to be brought away just as a ploughshare cuts underneath the soil and turns it up so as to leave a furrow. This must, of course, be done slowly and with great care, seeing that the groove required is extremely shallow and the wood from which it has to be cut has already been made very thin.

Glue the strip of purfling to be inserted, or both strips if two are desired, and gently squeeze *both together* into their grooves, care being taken that the small ridge of wood between the grooves is not broken. Make neat joints at the four corners, and remove

any superfluous glue with the camel-hair brush. When the glue is dry, take away the projecting surface of the purfling with a very sharp knife, and finish off with the scraper and glass-paper.

CHAPTER XII.

THE NECK.

TAKE a piece of maple 10 inches long, $2\frac{1}{3}$ inches wide and $1\frac{2}{3}$ inches thick, and plane it smooth on all four faces. The maple for the neck is usually selected from wood well marked and figured, so as to be as ornamental as possible. The purfling of the body, and the scroll of the neck are the only parts of the instrument which are simply ornamental without being useful, but there is no reason why the useful parts should not be as ornamental as possible.

Take the finished neck which you have bought as a model, and draw the outline of the model on the piece of maple. Then with the T square, draw a line all round the wood $5\frac{1}{3}$ inches from the end where it is to be fastened to the body. This line will be

at the point G, Fig. 37, which is the place where the peg-box begins.

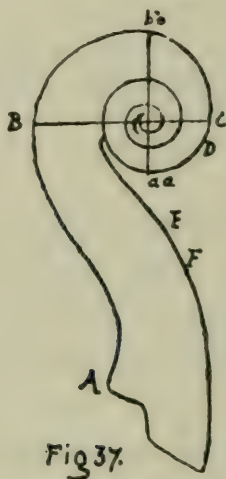


Fig 37.

Take the compasses, open the points $\frac{5}{6}$ inch which is half the width of the narrow side; mark a point at each end and draw on each of the narrow sides a pencil line the whole length of the piece. Open the compasses $\frac{1}{2}\frac{1}{4}$ inch, place one point at the angle where the long line meets the transverse line at G, and mark on that transverse line on both sides of the line which cuts it, a point $\frac{1}{2}\frac{1}{4}$ inch from the long line, between which points there will, of course, be $\frac{1}{2}$ inch.

This $1\frac{1}{2}$ inch shows the width of the neck at the beginning of the part held by the hand, and also the width of the nut (the small piece of ebony over which the strings pass out of the peg-box).

Open the compasses $\frac{5}{8}$ inch, and put one leg on the angle made by the long line and the cross line on the narrow side opposite to that on which you have been working, and mark as before upon the cross line two points on either side of the long line, the distance between which will be $1\frac{1}{4}$ inch. This $1\frac{1}{4}$ inch is to be the thickness of the neck at the point where it joins the belly.

Now fasten the neck to the bench with the hand-vice, the broad side upwards, so that the scroll end projects over the edge of the table, and cut away with the bow-saw all the superfluous wood. Begin at point G (Fig. 37) and proceed along the line F E up into the corner; then start from C and work past D round the curve to the corner point; start again from C, work round the top past B down to A. This gives a rough outline,

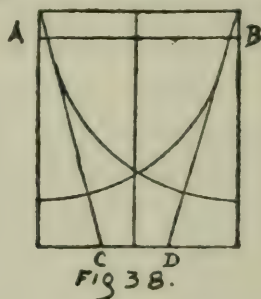
from G round to A, which must now, by means of chisel, knife and file, be brought to proper shape.

Then take your measurements from the model; cut away the wood from the point A to the part where the neck joins the body, and give to that part, and to the neck proper, which is to be held by the hand, its proper shape, finishing it off to the greatest nicety with scrapers, files and glass-paper.

Now fasten the neck down to the bench as before, and carve out with gouges, knives, etc., the curves of the scroll, beginning at the central "button" which, in Fig. 37, is crossed by the line B C and the dotted line *aa*, *bb*, the point where these lines meet being the centre of the button. Begin with the smallest gouge, and take a larger tool as the spiral requires it. Finish it with great care with the knife, scrapers and glass paper. Before beginning to carve one side, you will, of course, draw on both sides the lines B C and *aa*, *bb*. If this precaution is not taken, you will find it difficult to make the centres of the buttons correspond. Be

careful, in widening down from B to A, to maintain the gradual increase of thickness which you will find in your model, taking constant measurements as you proceed. Having finished off the sides, work out the two grooves round the edge A B C D. The neck is now finished, except hollowing out the peg-box, and preparing the foot to join the body. This foot will be glued on to the block, and level with it at the top, while the bottom will be glued to the projecting semi-circle on the back of the violin, and must, therefore, be filed until its shape exactly corresponds with it. From this point the foot will gradually increase in size until it attains the width already marked out. Draw down the foot of the neck a line in continuation of that already drawn, which divides it into two parts. The foot of the neck, or in other words, the surface which is glued to the block, will determine the height which the finger-board is to be above the body of the violin, and before you glue the neck finally in its place you must finish your finger-board according to the directions

given later, and, holding it with one hand in the place in which it is intended to be, adjust the foot of the neck so as to give to the finger-board its proper height when glued on. Fig. 38 gives a view of the foot of the



neck (A B C D) the part above the line A B being the part which projects above the level of the block.

The mortising of the peg-box and the placing and drilling of the peg-holes ought to present no difficulty. The conical shape of the peg-holes is obtained by means of a small tapered gouge.

In gluing on the neck, regard must be had to two points: The central line of the surface to be attached to the finger-board must make a straight line with the belly-joint, and that surface as well as the end or foot must

be so adjusted that while the proper height is given to the finger-board the centre of the scroll-buttons is intersected by an imaginary line drawn in continuation of the level at which the back is glued to the sides.

The time has now come to fix the neck. When the side pieces were put on, more wood was left at this place than was required, this must now be cut away, so as to allow the neck to fit in exactly. An inlet $\frac{1}{4}$ inch deep, must now be cut in the block— $\frac{1}{4}$ inch deep, that is to say, from the outer surface of the side-pieces, enough wood having, of course, been left at the end of the neck to allow for this inlet.

Before gluing the neck every precaution must have been taken to ensure its correct shape and position, and the neck should fit into the inlet so accurately as to require some little force to get it to its place. You will now want a piece of cork $\frac{1}{4}$ inch thick and 2 inches long by 1 inch broad.* Glue thoroughly

* Felt is preferable as it is not so liable to leave an impression on the wood.

the inside of the inlet, put the foot of the neck in its place, but the piece of cork on the back so as to cover the button, and, placing this cork on the beak of the hand-vice, screw down the screw on to the end of the neck. In half an hour unscrew it and see if the finger-board is at the right height. If so, the glue can be left to dry; if not, it must be readjusted, and the operation gone through until it is. In damp weather the end of the neck should be warmed before it is put in, and the glue will have a more binding effect if a good number of holes are made with a knife in the end of the neck, and in the small surface which fits upon the button.

CHAPTER XIII.

THE FINGERBOARD.

THE finger-board is so simple and so easily made that the best way will be to purchase one as a model. The amateur who has followed me thus far will have no difficulty in making one exactly like it from a piece of ebony. It is hardly necessary to say that its width at the narrow end must be adjusted to that of the neck, and that it must fit the neck accurately at the sides, and should join it so closely that they both appear as one piece. Be careful in gluing it on, not to mark the neck or the finger-board with the hand screws. The height of the finger-board varies according to the model of the instrument; its mean height at

the middle of its upper curve should be $\frac{7}{10}$ inch from the belly joint, but this will all depend upon the height of the bridge and the depth of touch required for the strings.

CHAPTER XIV.

THE NUT AND THE TAIL PIECE NUT.

THE nut is the small piece of wood over which the strings pass out of the peg-box, and the tail piece nut is the piece which resists the action of the string by which the tail piece is held to the button. Take a piece of ebony of the size for the nut, as to which the eye will be a sufficient guide. Its length will be determined by the width of the neck, with which it should exactly correspond. Its curve must correspond exactly with that of the finger-board, and its upper surface be $\frac{1}{16}$ inch higher. Its front, against which the finger-board is glued, will be perpendicular to the neck, and the upper surface in which the slits for the strings are cut must slope gradually down towards the peg-box, so as to

present a rounded surface on which the strings may rest.

The string-guard is usually a small piece of ebony about 1 inch long and $\frac{1}{4}$ inch square, which is glued into an inlet made in the block at the lower end. Its outer surface must be level with the side pieces, into which it must fit accurately. An edge should be left upon it to stand $\frac{1}{16}$ inch above the belly, and it should be trimmed to the surface of the latter. The edge over which the strings pass must be rounded so that they are not cut. The four slits in the nut should not be cut, but filed out with a rat-tail file.

The making of the button presents no difficulty. It is a sort of drawer-handle on a small scale, made of ebony, with a projecting limb about 1 inch long, and $\frac{3}{8}$ inch in diameter, which fits accurately into a hole of that size bored through the sidepieces and into the block, and we are now ready to begin to varnish.

CHAPTER XV.

VARNISHING AND POLISHING.

HOWEVER carefully the work has been done. it is almost certain that on looking it over closely you will find some slight roughness or unevenness, some place where glue has trickled out, some part of the edges not nicely rounded, or some other fault overlooked. These faults must now be searched for and remedied by file, glass-paper or other suitable means. When all is perfect, polish with very fine glass-paper the whole surface.

Now take a clean sponge, dip it in cold water, squeeze it nearly dry, and gently damp (*not wet*) the instrument all over. Then polish as before until the surface has the appearance of having been covered with a very thin coat of poor varnish.

The making of the varnishes, both spirit and oil, is treated in the next chapter.

The best tool to lay on the varnish is a flat camel-hair or sable brush, about an inch wide, and which has never been used. The varnish being ready, take a small quantity in a glazed earthenware vessel. Have as little varnish as possible at a time in the brush, and take only two strokes, one up and the other down, over each part of the wood. Take care and "lay it off" evenly, as a painter would say—that is, work so that the marks of the brush are invisible, and as if the varnish had all been put on with one simple stroke. Try your hand first on two pieces of maple and pine, both treated and prepared for varnishing just like the violin, and do not touch the instrument with varnish until you have put two coats of oil varnish on each piece as an experiment. When you have succeeded in getting a brilliant surface, from which brush-marks are totally absent, you can venture on your violin. After each coat of *spirit* varnish, polish with a linen cloth, the older the

material, and the softer its texture, the better will it be for your purpose. You cannot obtain a really brilliant lustre with spirit varnish unless you polish with linen cloth after each coat.

CHAPTER XVI.

VARNISHES AND COLOURING MATTER.

HAVING completed the violin, the next step is to varnish it, and there are two modes of carrying out this process. The one is genuine, the other is a sham; and if the amateur has succeeded in making an instrument worth varnishing at all, I strongly advise him to varnish it that it may pass for what it is, a new instrument, and not pretend to be what it is not, an old one. New instruments are made to look old by colouring the wood before the real varnish is applied, and leaving those parts uncoloured which in an old violin shows the effects of wear and tear. This fraud is on every ground to be deprecated, for nothing will be gained by it, while the genuine workman, who cares more for turning out a good violin than he does

for making money by dishonest means, will feel that by such a fraud he loses what money can never buy, self-respect. The proper way to varnish the violin is to varnish it all over without any previous colouring. This may be done either with plain or coloured varnish. Both are equally genuine; the fraud consists, as I have said, in making the violin look as though coloured varnish had been originally used, but worn away by long use. I shall now proceed to give precise directions for making the two kinds of varnish used for the violin, viz., oil varnish and spirit varnish, as well as the mode of colouring the varnish in various tints when colouring is desired.

The best, though most troublesome, is

OIL VARNISH.

This is vastly better than spirit varnish, as it is more beautiful, more durable and more elastic; moreover, it needs no polishing. Two coats, properly applied, will generally be found sufficient, whereas spirit varnish requires six or seven applications.

The ingredients of good oil varnish are three: amber, spirits of turpentine and linseed oil. The latter, however, is such a bad drier, that it must be used in the form known as "boiled oil." The operator could, of course, perform the operation of "boiling" it himself, but as it is very dangerous unless carried out with great care, and as boiled oil can be purchased ready for use without any trouble or risk, I think it better not to give any recipes for rendering linseed oil a better drier.

I strongly recommend that varnish that is sold, in any quantity, ready for use, by Messrs. Winsor and Newton, artists' colourmen, London, who prepare boiled oil of the very finest quality for artists, so that the violin maker may rely upon obtaining the best procurable. Cheap common boiled oil is nearly black, and is worse than useless for the purpose under consideration.

The following is the way to prepare oil varnish. The materials required are ;

Amber	.	.	.	.	.	4 ounces.
Boiled oil	.	.	.	.	.	2 ounces.
Oil of turpentine	.	.	.	.	.	4 ounces.

Break up the amber into pieces the size of peas, and having prepared a charcoal fire, put the amber into a glazed iron vessel never before used, and with it a spoonful of the turpentine, and put the pot on the fire and the cover on it. A quarter of an hour's warming will suffice to melt the amber, but it must now and then be stirred with a strip of pine wood. When the amber is melted down, take the pot from the fire, stir it till cool, and add the oil very slowly, stirring all the time so as to thoroughly mix the ingredients, and then add the turpentine, to which you have previously given the colour desired.

The colouring matters must simply be powdered and put in the turpentine to dissolve, some time before it is wanted for making the varnish. The colouring matters are here given :

Yellow.—Aloes, gamboge, turmeries or saffron; these will give various tints of

yellow, from light golden to deep, as may be desired. The effect of golden varnish is very brilliant.

Red.—Dragon's blood or Saunder's wood. By mixing with yellow any tint of light red can be obtained.

Brown.—Madder or logwood.

It must be remembered that each coat adds a slight depth of colour to the previous one. These colouring matters are suitable for colouring either oil or spirit varnish. It is sometimes the practice to make a quantity of any colour in as small a portion of turpentine as will dissolve it, and keep it for dilution to the requisite tint when required.

The following are recipes for oil varnishes of different kinds :

Amber, coarsely powdered . . .	2 oz.
Venice turpentine . . .	2 fl. drs.
Prepared linseed-oil . . .	1½ fl. oz.
Oil of turpentine . . .	2 fl. oz.

Amber, fused	2 oz.
Oil of turpentine	5 „
Drying linseed-oil	5 „
Amber, fused	4 „

Lac	1 oz.
Drying linseed-oil	4 „
Oil of turpentine	8 „

Dissolve the lac separately, then add the amber and thoroughly dissolve by heat.

Clear and pale African copal	1 lb.
Pale drying oil	1 qt.
Rectified oil of turpentine	3 pt.

Boil the copal and drying-oil until stringy, then thin with the turpentine, and strain immediately into the store jar. This varnish is hard and durable, and dries hard in from twelve to twenty-four hours.

Clear pale rosin	3½ lbs.
Oil of turpentine	1 gal.

Dissolve. This is the varnish generally used on the cheap violins.

Colourless Copal Varnish.—To prepare this varnish the copal must be picked, each piece then broken, upon which a drop or two of rosemary oil is to be poured; the pieces which become soft upon the application of the oil are those only to be used. Those pieces having been selected are to be ground

to a fine powder, and then sifted. Place the powder in a glass vessel and add to it a corresponding volume of the rosemary oil; stir for a few minutes, when you will have a thick liquid. Leave the liquid to rest for two or three hours, then add a few drops of pure alcohol, and mix slowly, after which reduce with alcohol until the required consistence is obtained. This is a clear and beautiful varnish.

The following are recipes for spirit-varnishes of different kinds:

Elemi	.	.	.	½ oz. or 1 part.
Mastic in tears	.	.	½ „ „	2 „
Seed-lac	.	.	1 „ „	2 „
Sandarac	.	.	2 „ „	4 „
Venice turpentine	.	.	1 „ „	2 „
Powdered glass	.	.	1 „ „	4 „
Alcohol	.	.	16 „ „	32 „

Mastic	.	.	.	.	1 dr.
Sandarac	.	.	.	.	1 „
Lac	.	.	.	.	6½ „
Alcohol	.	.	.	.	5 fl. oz.

Gum sandarac	.	.	.	.	4 oz.
Seed-lac	.	.	.	.	2 „
Mastic	.	.	.	.	1 „
Benzoin in tears	.	.	.	.	1 „
Powdered glass	.	.	.	.	4 „
Venice turpentine	.	.	.	.	2 „
Alcohol	.	.	.	.	32 „

Seed-lac	.	.	.	.	5 „
Sandarac	.	.	.	.	2 „
Elemi	.	.	.	.	1½ „
Venice turpentine	.	.	.	.	2 „
Powdered glass	.	.	.	.	5 „
Alcohol	.	.	.	.	24 „

Coarsely powdered copal and					
glass of each	.	.	.	.	4 oz.
Camphor	.	.	.	.	½ „
Alcohol (64 O. P.)	.	.	.	.	1 pt.

Heat the mixture (with frequent stirring) in a water bath, so that the bubbles may be counted as they rise, until solution is complete, then decant the clear portion.

Mastic	.	.	.	.	¼ lb.
Turpentine varnish	.	.	.	.	2½ fl. oz.
Alcohol	.	.	.	.	1 pt.

This is the spirit-varnish so often seen upon the clear German violins.

Colourless Spirit Varnish.—Dissolve $2\frac{1}{2}$ oz. picked orange lac in a pint of rectified alcohol, and boil well for a few minutes with 5 oz. of well burnt and recently heated animal charcoal. A small quantity of the solution should now be filtered, and if not colourless add more charcoal. When colourless press the liquor through a piece of silk, and filter through fine filtering paper. This varnish must be used in a room where the temperature is about 60 degrees Fahr. It does not chill or bloom, and dries in a few minutes.

CHAPTER XVII.

THE VARNISH.

THE MS. "Violin Notes" left by Ole Bull, contain the following interesting observations :

"In a search after an elucidation of this so-called lost art, three facts immediately present themselves: first, this varnish was employed by the very earliest of the Italian makers as well as the later; second, its use was common only in Italy; third, it ceased to be applied to violins after A.D. 1750-60.

"In texture this varnish is extremely supple; it will yield to pressure, but breaks or scales off under a sudden blow. It is entirely transparent, and of all shades of brown, red and yellow. The vehicle in which the gums and colours are dissolved is an oil. Applied to a violin, it compacts the tone together, without

rendering it shrill or harsh, and gives additional beauty to the wood. That its ingredients were indigenous to the Italian soil is out of the question. It is well known that much of the maple used by the violin-makers of that day came from Turkey. Imported to Venice, it was employed in the construction of oars, etc. The extremely curly pieces, owing to their liability to fracture under rough usage, were consequently rejected, to be appropriated by the violin-makers. Venice and Genoa held great command over the entire Eastern trade, and undoubtedly through these ports came the various gums and colouring substances of which this varnish was made.

“Turning to other countries of Europe—Germany, France and England—and examining the productions of their most celebrated violin-makers contemporaneous with the Cremonese school, scarcely a trace of the Italian varnish is to be met with. In German instruments the varnish is distinguished by extreme hardness, a glassy lustre, and an absence of all delicate shades of

colour. The vehicle or menstruum, moreover, is alcohol. In France, the colouring was sometimes good, but in general too pronounced. The varnish of the old English makers lacked transparency. In both these countries the vehicle was oil, but the varnish in quantity and texture differed essentially from the Italian.

“Three questions occur: first, was this manufacture a secret? second, how was this secret lost? third, are there any clues for perusal and examination? Answers to these questions should clear up the mystery of this so-called lost art.

“To begin, then, with the first question, was the manufacture of this varnish a secret? There is no reasonable doubt that it was, but only in a certain way. For a period of about two hundred years, from the time of Gaspar da Salo to that of the Bergonzi, the varnish was common to every Italian violin-maker. Cremona had no monopoly, for the knowledge and use of it extended to Padua, Venice, Rome and Naples. It is impossible, therefore, during this long time to say that

the selection of ingredients or the method of preparation employed in the manufacture of this substance, so well known and widely used, were in any sense a secret. But a little later quite a change is observable. From a hundred Italian instruments of this later date, only a notable few can be selected as possessing the true varnish; and that this marked characteristic in the case of these few is not the result of mere chance is apparent from the fact that the artists who made them have consistently applied it to all their productions. From about 1745 to about 1760, then, the manufacture of this varnish may be properly called a secret, as being confined to a chosen few.

"A bitter rivalry had always existed between the Neapolitan, Venetian and Cremonese schools. Alessandro Gagliano, probably a pupil of Stradivarius, had established himself at Naples. Dominico Montagnana and Sanctus Seraphino were the masters of the art in Venice. The Cremonese makers seem to have relied on their sonorous, well-selected wood, their

established principles of construction, and their ancient reputation; the Venetians, on the beauty of their wood, and careful finish; and the Neapolitans on their exceedingly low price.

“As a knowledge of the varnish became at last confined to a few, instances are not wanting of the persecution of such by their less fortunate fellow-workmen. It is quite evident, that, apart from any considerations of beauty, the importance of the varnish as an acoustic element was well recognised.

“The second question now presents itself: how was the secret lost? A careful and repeated examination, extending to a vast number of objects, reveals the fact that the varnish of the Italian violin-maker of the time of Stradivarius and before him was common to the painter, the varnisher, and the gilder as well. Let an ancient piece of Italian furniture, a chair, a cabinet, the case of a spinet or harpsichord, be examined, and provided it has escaped modern retouching, the varnish might be by Stradivarius himself. Generally it is colourless, then the

quality and texture are the indications, but occasionally it is of brilliant hues, and then it proclaims itself to the eye at once. Let specimens of a later date, say, 1760, be examined, there is no such varnish. This is smooth, fairly lustrous, hard and durable. The chair of 1725 presents a surface broken and worn away, that of 1760, one comparatively smooth, and fairly able to endure further vicissitudes of time.

“Between the years 1740 and 1760, great changes in the manufacture of varnish were introduced. The old soft gums and their menstrua, capable in themselves of dissolving them, were discarded in favour of newer and more complicated processes producing a result more durable and unchangeable under exposure and rough wear.

“The old fashion of ornamenting all articles of furniture, whether of ornament or utility, with carvings, had given place to a more sober style. Broad, unrelieved surfaces, depending on the intrinsic beauty of their material, were found a relief to the eye tired with unravelling the mazes of complex

carving or painted arabesque. The old, soft, badly wearing varnish no longer sufficed for protection and covering of such surfaces; hence the new processes, and, for such utilitarian purposes, superior results. The hard copal gums, hitherto undissolvable, or only partially so, were found to yield entirely upon proper heating and fusion. In 1750 a patent, covering a period of twenty-five years, was granted by the King of France to one Simon Martin, a fan painter, for the process of making varnish from amber, by driving off the succinic acid by means of heat, and the subsequent combination of the residue with oil. From that day to the present, various improvements in this art have gone on uninterruptedly. The field of discovery, the gates to which were opened by such pioneers as Simon Martin, being once entered, the problem of durability, hardness and unchangeableness was soon solved. But with the laying aside of the old recipes, the Italian varnish became a lost art. The knowledge of its composition, naturally confined to the general manufac-

tures, was forgotten. There is no doubt that some of the Cremonese and other makers knew how to prepare it, but, as has been shown, its use was not confined to them. The new ingredients, the copals, amber, etc., would naturally supersede the old as articles of import, and so by degrees those who possessed the secret, for a secret it was, certainly regarded by its latest possessors, would find increasing difficulty in obtaining the old constituents. Moreover, the days of violin-making in Italy were over. England, France and Germany were eager competitors, the stolid build of the first, the gaudy colour of the second, the baked wood of the Mittenwalder, or artist of the Black Forest, and the general cheapness of all, held the market. And so it has happened that the art of the old varnish is not lost, but buried in the dust under the wheel of progress. For two hundred years it was in the hands of a nation; and though now a desire for this forgotten knowledge is confined to only a few, it would be absurd to say that persistent inquiry must fail to unravel a skein of so many ends.

"The third question now presents itself : are there any writings or clues for perusal and examination? There are many. An ingenious Frenchman, who long ago wrote a treatise on varnish, has given the following list of authors who have treated upon this subject :

"Alexis, Piedmontese (real name of author, Hieronymus Ruscellai), '*Secrets des Arts*,' Milan, 1550.

"Tiavoranti : '*Miroir Universel des Arts et des Sciences*,' Bologna, 1564.

"Anda : '*Recueil Abrégé des Secrets Merveilleux* ; —, 1663.

"Zahn, Jean, '*Oculus Artificialis*,' etc.; Nuremberg, 1685.

"Morley, C., '*Collections*,' London, 1692.

"Coronelli, Vincent, '*Epitome Cosmographique*,' Venice, 1693.

"Pomet, '*Histoire Générale des Drogues*,' Paris, 1694 (reprinted 1736).

"Buouanni, Phillipe, '*Traité des Vernis*,' Rome, 1713.

"Here is a succession of treatises, the earliest written about the time of Gaspar da

Salo, and the latest during that of Stradivarius. Here are hundreds of genuine recipes. Is any one of them the right one? Patience and perseverance are necessary, much fitting of old names to their nomenclatures and many tiresome comparisons, but these once made, the desired result may be obtained, and the new varnish may possess the old coveted lustrous softness and suppleness. And the colours? the brown, the red, and the yellow?—hidden under quaint and obsolete names, they are all indicated by one and another of these authors, and all are soluble in the one vehicle, forming a coloured oil varnish, clear and transparent, which, however long kept, will let fall no sediment.

“There is still another branch of this subject which has never, or very rarely, been specified, and this is the *ground-toning*. In all Italian instruments the wood appears to be permeated with a colour varying in intensity from pale yellow to almost orange. This colour is quite distinct from that of the varnish; for, however faded by exposure and

other causes the latter may be, the ground-tone almost always retains its colour. The violins with red varnish afford the finest examples of this ground-toning. On such its tawny yellow is the most intense, and offers a splendid foil to the superimposed colour, toning and giving life to it. How it was composed or applied, whether as a wash or stain, or as a distinct varnish, none of the authors give any information. But from their miscellaneous lists of the drugs, dye-stuffs and colouring matter common to the Italian markets, it is quite possible that a selection could be made, which would fulfil all the required conditions of colour and stability.

"But though supplied with the ground-tone, another element is needed before the exact reflex of the Italian varnish can be reproduced, and that is the natural colour of the old wood.

"The problem of the old varnish is solvable by anyone who deems the reward worth the trial of patience and perseverance, two elements most effective in the task of interlining the broken sentences of tradition."

CHAPTER XVIII.

A MATHEMATICAL METHOD OF CONSTRUCTING THE OUTLINE.

IN constructing an outline according to the directions now to be given, it is necessary to observe great accuracy in the working, to ensure a satisfactory result.

First draw a perpendicular line 14 inches long, and divide it accurately into 72 equal parts. Then draw at right angles to line, the following :

A line through point No.	8	A—A	See Illustration.
„	14	B—B	„
„	16	C—C	„
„	20	D—D	„
„	21½	E—E	„

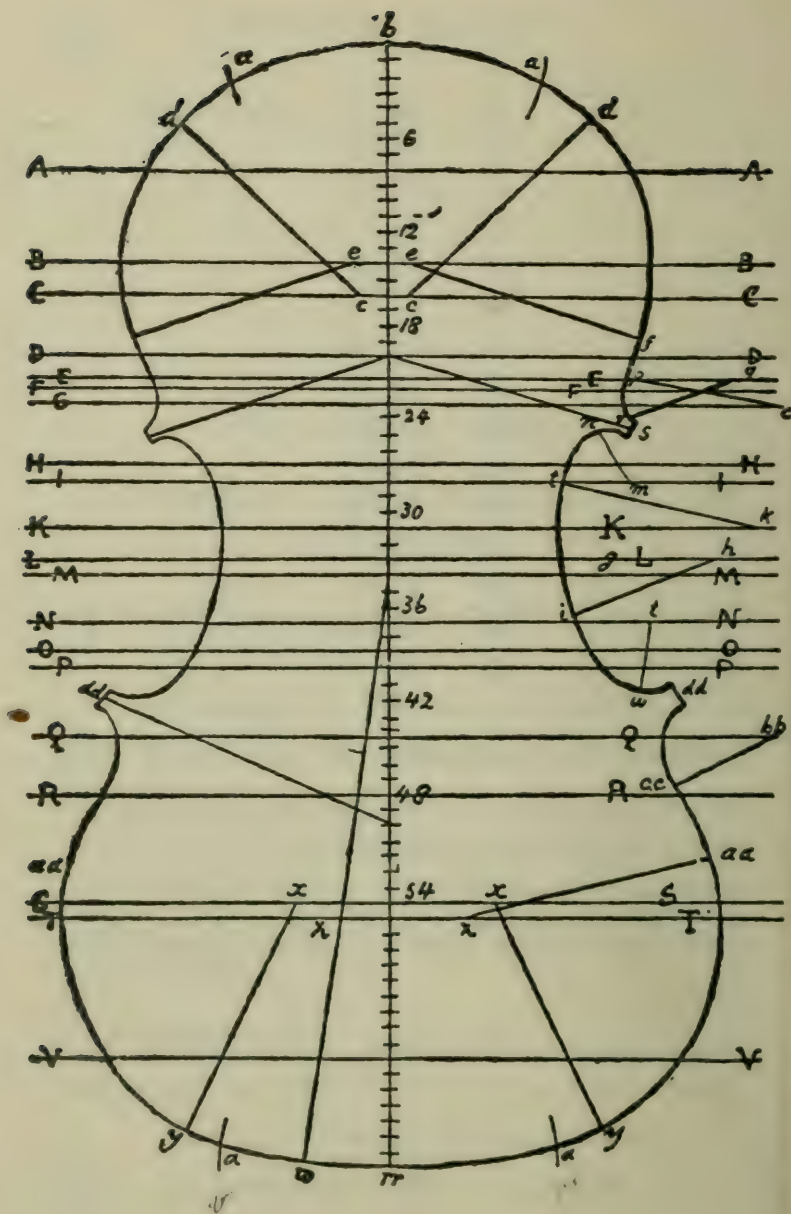
A line through point No.	22	F—F	See Illustration.
„	23	G—G	„
„	27	H—H	„
„	28	I—I	„
„	31	K—K	„
„	33	L—L	„
„	34	M—M	„
„	37	N—N	„
„	39	O—O	„
„	40	P—P	„
„	44½	Q—Q	„
„	48	R—R	„
„	55	S—S	„
„	56	T—T	„
„	65	V—V	„

Open the compasses to the width of 9 parts, put one of the feet at point *b*, and draw the two little curves *aa*.

Open the compasses to the width of 24 parts, place one foot on point 24, and draw the arc *aba*.

Open the compasses to the width of 2 parts, and mark off this distance upon each side of the perpendicular, as at *cc*.

Put one foot of the compasses at *c*, open



to *a*, and describe the curve at *aa*. Do the like on the other side.

Open the compasses to the width of one part, and mark to right and left of No. 14, on the line *BB*, two points *ee*; make each point the centre of a circle, as in the last paragraph, with radius *eA*, and draw the arcs *A D* on either side.

On the line *L L* measure to a point $22\frac{1}{3}$ parts from the perpendicular; put one foot of the compass at each of these points *h* and describe from the centre *h* with a radius of 11 parts, the arcs cutting the lines *LL* and *PP*.

In the same way find on line *KK* 2 points $23\frac{3}{4}$ parts from the perpendicular, and from centres *kk* open the compasses to the point where the arcs last drawn, join the line *LL*, and continue the arc from the line *LL* until it meets the line *HH*.

Open the compasses to the width of 11 parts, place one foot upon point 72, and draw the two small lines *vv*, then place one foot on point 35, and the other on point 72, and draw the curve between these two lines, *vv*.

Open the compasses to the width of 6 parts, and placing one foot on point 55, mark on the line SS the two points *xx*.

Take each point *x* as a centre from *x* to *v* as a radius, and continue the curve from *v* to the line VV.

Open the compasses to the width of 4 parts, place one foot on point 56, mark the 2 points to *zz*.

Take each *z* as a centre, open the compasses to the point where the arcs last drawn joins the line VV, and continue the curve from the line VV to the line RR.

Mark off on line GG two points *oo*, each distant from the perpendicular $24\frac{1}{2}$ parts: open the compasses from point *o* to point *f* on either side, and draw the curve from point *f* to the line FF.

On line II mark on each side of the perpendicular at the distance of $14\frac{2}{3}$ parts from the perpendicular 2 points *mm*; open the compasses from *m* to where the curve joins the line HH, and trace on each side the curve from the last mentioned point to the point *n*.

On line EE, find 2 points 22 parts from the perpendicular on each side qq ; open the compasses from point q to point p on line EE, and draw the small curve from p to r on each side.

Open the compasses from point 20, $16\frac{1}{3}$ parts, and draw the two corners ss .

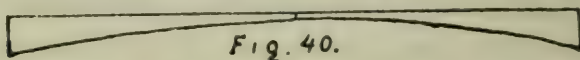
On line QQ open the compasses 24 parts from the perpendicular, and mark on each side the point bb ; from point bb , open the compasses to the point where the line RR is joined by the curve from V to R, and continue the curve from cc to dd .

On the line NN open the compasses $16\frac{1}{2}$ parts from the perpendicular, and mark on each side the point t ; open the compasses from point t to the point where the line PP is joined by the curve from the point i and draw the small curve.

Open the compasses to the width of $19\frac{3}{4}$ parts from point 50, and trace on each side the corner dd .

We will now proceed to show how the arch of the violin is made in the direction of the perpendicular.

Take a strip of hard wood, .2 inches wide, a little longer than the perpendicular, and thick enough not to bend too easily, and find its centre, across which draw a line. Open the large compasses 216 parts, that is, three times the length of the perpendicular, and, having fixed the strip upon the table, draw upon the table a perpendicular line in continuation of the line drawn across the centre of the strip, place one end of the compasses on the perpendicular line upon the strip not too near to the upper edge, and the other point upon the perpendicular drawn upon the table, and draw upon the strip the



arc shown in Fig. 40. When cut away this arc will give the proper arch of the violin.

The length of the *f* holes is 15 parts; the incision on the inner side of each should be exactly opposite point 40; the head commences opposite point $32\frac{1}{2}$, and the foot ends opposite point $47\frac{1}{2}$. The diameter of the hole at the head is $1\frac{1}{3}$ part, that at the foot $1\frac{3}{4}$ parts; the inner edge of the upper holes should be 9 parts asunder, and the

inner edges of the lower holes 23 parts, as under (see Fig. 41).^{*} For all measurements

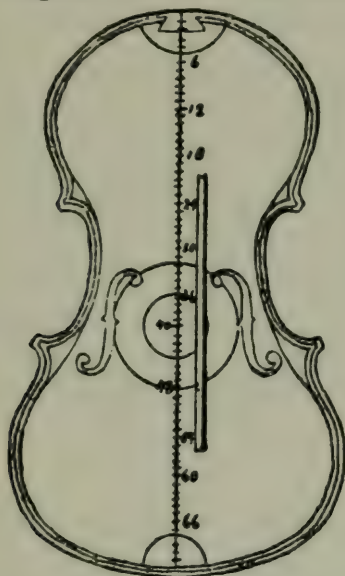


Fig. 41.

required in this method a rule 72 parts long and accurately divided into 72 parts will be found of great service.

THE THICKNESS OF THE BACK.

Point 42 is the starting point for obtaining the proper thickness of the back. With the

^{*} Fig. 41. The position of the bar shown in the above illustration is that found in old Dutch and other early made instruments. The position of the bar in modern instruments will be found under paragraph headed "The Bar."

compasses describe from centre 42 a circle having a radius of $4\frac{1}{3}$ parts; all the wood contained in this circle should be precisely 1 part thick. Then open the compasses 12 parts and draw another circle from the same centre, the wood in which will gradually fall off from 1 part thick at the edge of the inner circle to $\frac{2}{3}$ of a part at the edge of the outer circle. From this line to the side pieces, the thickness will gradually fall away in all directions to $\frac{1}{2}$ part (see Fig. 42).

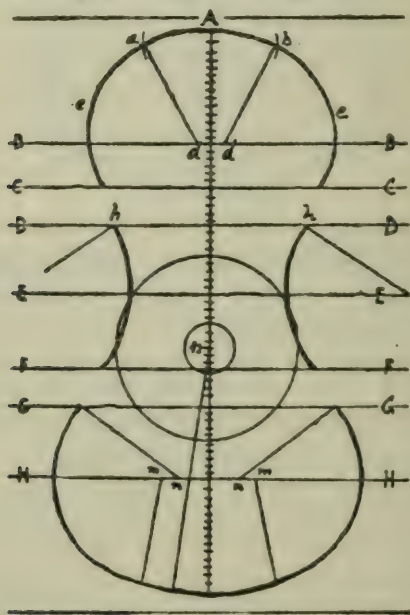


Fig. 42

THE THICKNESS OF THE BELLY.

Point 40 is the point of departure. Open the compasses 4 parts and draw a circle with point 40 as its centre. The wood in this circle must be $\frac{2}{3}$ part thick; open the compasses 9 parts, and draw another circle. Then, as with the back, gradually thin off from the inner circle till the wood at the outer circle is $\frac{1}{2}$ part thick, and from thence thin off again to the sides, where it should be a good $\frac{1}{3}$ part in thickness.

THE BAR.

The bar should be 56 parts long, 1 part thick, 2 parts high in the middle, diminishing gradually to $\frac{2}{3}$ part at the ends. Its position should be parallel to the joint, slightly inclining inwards at the top end, or about $\frac{3}{32}$ inch in its whole length, and precisely upon the edge of the inner circle. The length of the bar can be readily gauged by measuring off $1\frac{1}{4}$ inch (or 17 lignes French measure) from the top and from the bottom of the belly, the ends of the bass bar should come to these points. The bar should never be

further away from the centre than $8\frac{1}{2}$ lignes at the top and $9\frac{1}{2}$ lignes at the bottom. The slight slope at the present time given to the bar should be in this proportion also.

THE SOUND-POST.

The sound-post should be $\frac{1}{4}$ inch in diameter, and placed behind the foot of the bridge. Other particulars respecting this important part have been given in previous chapters.

THE BRIDGE.

The bridge should have 8 parts between outer edge of the feet; its height should be $6\frac{1}{2}$ parts.

THE NECK.

The neck should be 27 parts long from the extremity of the peg-box to the sides of the violin.

CHAPTER XIX.

THE REMAINING ACCESSORIES OF THE VIOLIN.

THESE are the tail-piece, bridge, pegs and strings, which can all be bought of any instrument dealer.

I might give the amateur minute directions for making the first three named, but as I only propose writing on the making of the *violin*, I have expressly omitted matters which merely pertain to the fitting-up of the instrument preparatory to playing. When Luigi Tarisio came to Paris with a number of priceless Italian violins in his possession, he brought nothing *but* the violins—a mere assortment of wooden boxes, as turned out by the master hands of their makers. Those parts which gave a finished *appearance* to the instrument were wanting. An old "Strad" may in its time have had fifty tail-pieces or a score of finger-boards; and however

essential they may be, the parts above-named are only "fittings."

The tail-piece is fastened to the button by a piece of violoncello D string, the knot of which should be firmly tied. Different modes of fastening are adopted. Some tail-pieces have two holes pierced through them and in this case the ends of the cord should be put through and tied so that the knot comes in the groove of the button. Others have the holes pierced in the end of the tail-piece, and a hollow scooped on the under side to allow the knot to stand within the level of the wood so as not to touch the belly. The amateur will select the pattern he likes best.

The strings are an important factor in the production of the tone. They should always be gauged before they are put on. A string gauge can be bought for sixpence, and when the thickness and quality of strings best suited to a violin are ascertained, no variation should be permitted. The following passage from Mr. Davidson's work will be useful to the amateur :

"A good violin string ought to be perfectly cylindrical from one extremity to the other, having a regular thickness throughout, and possess the necessary elasticity. A packet of strings upon being compressed, or bent together, ought not to change colour, or the united parts to break, but to quickly return to their original shape. They ought also to be transparent throughout their entire length, like a thread of glass, and possess no wavy or curled markings. The best second and third strings are of a transparent white; the first not being so white, but perfectly transparent. If the first strings are very white, we may safely assume that they have been made from the intestines of animals which have been prematurely used by the manufacturer. The strings should be now and again oiled, preserved in oil-paper or bladder, and laid aside in covered tin boxes, in a dry place. For oiling the strings a small piece of woollen or other cloth may be used, upon which a few drops of olive or almond-oil are poured. If olive-oil is used, it should be purified by a mixture of lime

and lead, until it is perfectly limpid. The first string should require a tension of 15 lb. to bring it to opera pitch; the second 17 lb.; the third and fourth about the same as the first."

We must carefully observe that the tone of any violin is very perceptibly affected by the size of the strings, as if not in due proportion the one to the other, no uniformity of tone or power will be obtained. The peculiarities of the strings which prove individually suitable to the different classes of violins must also be judiciously studied, as the instruments vary so much in this respect that a string which is perfection to one is destruction to another, but generally speaking, all the ancient instruments require to be lightly strung, in order to effectively evoke their purity of tone and freedom of vibration. If the strings are too thin or light, the tone of such will be weak and feeble, whilst on the contrary, if too thick or heavy, the sounds will be hard and coarse, and an unnecessary strain and pressure will be exerted on the bridge.

Many of the common-class violins require the strings to be *over-tight* ere they can be brought to pitch, causing endless ruptures, but a well-made violin never requires this *over-straining* or tightening in order to bring it to pitch. The fingering also varies on some violins, even although they may be of precisely similar lengths of fingerboard.

From the preceding cursory remarks the reader will easily discern that the strings form an important item in the correct adjustment of the instrument.

The pegs must be accurately adjusted, and when properly fitted the holes should fall so as to allow the strings to run from the hole to the nut without crossing each other. A mixture of finely powdered chalk and rosin will be found the best means of making the pegs move freely and stay where they are left without pressure.

The bridge is ably treated by Ole Bull in his "Violin Notes," and the following passage will afford the necessary information on this point, and also with respect to the sound-post and bow :

THE BRIDGE.

“The position of the bridge should be such as to affect the whole violin equally, and not to favour one tone more than another.

“The centre of the bridge should be directly over the centre line of the top. Whether it should stand slightly backwards or forwards of, or directly on a line drawn across the top from the inner notches of the / holes, will depend upon the character of the instrument, and can only be determined experimentally. It should incline towards the tail-piece in order to better withstand the forward pull of the strings in tuning.

“The construction of the bridge has great influence upon the tone. Thinness of the centre of the bridge tends to make prominent any nasal quality or shrillness latent in the instrument. A proper solidity conveys sweetness and compactness, but too great thickness muffles the tone.

“High-built violins mostly require low bridges, and such should be particularly thick at the edges where the strings rest.

"The bridge should be perfectly flat on the side toward the tail-piece. It may be slightly convex on the other side.

"The material of which the bridge is made should be invariably maple. That which is known as the silver-grey maple is preferable to the brown or yellow, as having a more close and elastic grain.

"The incisions in the sides of the bridge should extend each one third of the distance toward the centre. The French model of Aubert, of Mirecourt, though open to some objections in special cases, is one of the best. These bridges are made of excellent wood, and are thick and strong.

"The top of the bridge should be thick. Properly constructed, a bridge may be made quite heavy, and so made it will always convey a rounder and fuller volume of tone. The distance measured along the top between the G and E strings, should be $1\frac{5}{8}$ inch. The G string should be $\frac{1}{4}$ inch above the finger board at its larger extremity; the E string, $\frac{5}{32}$ inch. The average height of the feet of the bridge should be

about $\frac{3}{16}$ inch. The thickness at the base, a scant $\frac{5}{32}$ inch; at the top a full $\frac{1}{16}$ inch. The feet should be $\frac{3}{16}$ inch long.

THE SOUND-POST.

“In general the sound-post should stand from $\frac{1}{8}$ to $\frac{1}{4}$ inch to the rear of the right foot of the bridge. Its outer edge should be in line with the outer edge of the foot. From this position its upper or lower end, or both, may be moved with advantage to secure certain qualities of tone. It should in all cases fit the curves of the top and back absolutely. Moving the lower end toward the centre favours the lower strings. If the lower strings are weak and the upper at all sharp or hard in tone, then a very loose post should be used. If the reverse is the case, a long and tightly fitting sound-post is required. Moving the upper end outward will help all the strings, if the tone before was hard and shrill; but if the upper strings happen to be dull and heavy, then the post should stand a little inside the line of the foot of the bridge, and a little further back.

The sound-post should be made of fine-grained soft spruce. The grain should cross that of the top, as this will prevent the marring of the inner surface of the top in putting the post in and adjusting it.

THE BOW.

"I use a bow longer by two inches than the ordinary standard, a powerful, heavy bow is required for four-string passages and many *tours de force*. The bow, while elastic, should be extremely stiff, so that if dropped upon the strings the rebounds are very rapid. It should have weight to give force to these rebounds, as in many passages the weight of the hand cannot be applied to assist the bow; as in the tremolo, arpeggio and staccato volante. In this last example the bow is thrown upon the strings and runs its length in a series of little rebounds, neither the fingers nor wrist having anything to do with the result. In order to graduate, as it were, the different colours of sound, we favour certain overtones by causing the hair to act

at greater or less distances from the bridge. The nearer we approach the bridge the more the upper overtones, and the nearer the neck the more the lower overtones will be favoured. In the first instance, the resulting tone resembles that of the trumpet; and in the second, that of the horn and clarinet. With a heavy bow, in *forte* passages, only slight assistance is needed from the hand. The wrist is not cramped or stiffened in producing the pressure. In *piano* passages, the little finger should partially sustain the weight, and the stick should be inclined toward the neck, so that only part of the hairs act upon the strings.

"The great stiffness and elasticity of the heavy bow gives a freer, clearer tone than can be produced by one of a lighter and more sluggish nature.

"The length of the bow is 2 ft. 6 inches, the length of the hair, 2 ft. 4 inches. The number of hairs is about 160. Half the hairs are put in one way, the other half the other. It is known that the hairs, as seen when magnified have little saw-like teeth running in

one direction. By thus dividing the hairs, they present the same friction on either the up or down stroke. The best hair is from Normandy. It should be round and even, and not flat in places."

The importance of a suitable bridge is paramount, and to further aid the amateur in its selection I append the following quotation from Mr. Davidson :

"The bridge plays a far more important part than is generally attributed to it. Its incisions and form have a great influence upon the quality of the instrument. It merits, therefore, all our attention. If we take a piece of wood, cut like a bridge, and glue it upon a violin, the instrument nearly loses its sound. It gets a little better if we form feet to the bridge; if we make lateral incisions in it, the sound improves, which improvement increases gradually until the bridge assumes the ordinary form. It is an astonishing thing that by trial we gradually arrive at the form of bridge usually adopted, and which appears to be better than any other. A multitude of trials have been made

before this important piece arrived at perfection. Everything has led to this result, that we cannot depart from the established form without detracting greatly from the quality of the instrument. Bridges have been made of deal with their fibres perpendicular and parallel to the belly, but the sound was found to be altered. The size and shape of the openings have been altered, but the beauty of the instrument has always been impaired. Let us examine the movement of the molecules of the bridge. If we take a plain bridge with two feet and a single string, the movement is tangential, parallel to the face of the bridge. If we make two incisions in it, the nature of the movement changes, and the sand is seen to move in several directions at once, while the bridge itself experiences movements of oscillation, and its molecules appear to execute vibrations in a direction normal to the belly. The effect appears to be to confirm the normal movements of the tables. The bar to which these oscillations are imparted, produces in the belly a similar movement over

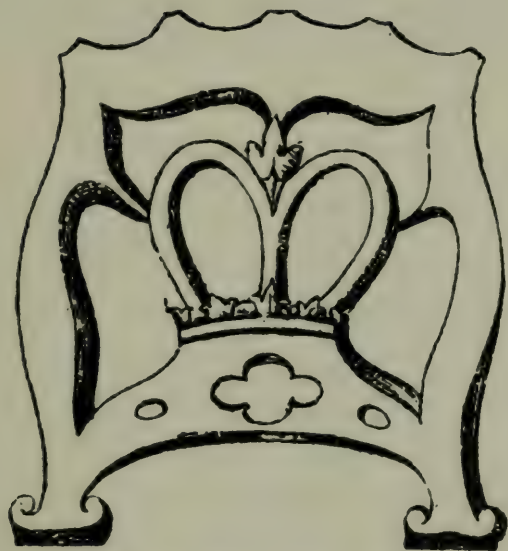
its entire surface, and prevents it from dividing into ventral segments by transversal nodal lines. All the parts of the instrument enter at once into vibration. Let us see how we can modify the effects of the bridge, by interfering a little with its oscillations. By placing a mute on the bridge the sound is almost null, and the bridge seems no longer to vibrate. It even appears to arrest the vibrations of the other parts of the instrument. The mute arrests its oscillations, and no longer produces the vibration of the belly. If we clamp the right foot of the bridge, the sound is weakened, but not to so great an extent as with a mute. On the other hand, if we repeat the experiment with the left foot, which ought to communicate its movement to the *bar*, the sound is incomparably weaker. It is evident that the left foot of the bridge produces the shocks which occasion the movement of the bar and of the belly."



FIG. 43. BRIDGE OF A VIOL WITH SEVEN STRINGS, THE BODY OF WHICH IS NOT CUT OUT EXCEPT AT THE TWO SIDES.



FIG. 45. BRIDGE OF A SMALL-PATTERN VIOLIN OF THE ANCIENT SCHOOL OF ANTHONY AMATI



**FIG. 44. BRIDGE OF A VIOL WITH FIVE STRINGS CUT THROUGH
IN EVERY PART.**



FIG. 46. BRIDGE OF A NICHOLAS AMATI.



FIG. 47. BRIDGE OF A STRADIVARIUS.

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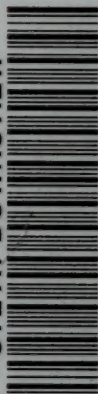
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